

Appl. No. «10/660,873 »
Arndt dated January 18, 2007

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claims 1-32 (canceled).

Claim 33 (Previously presented): A method according to claim 34 further comprising:

writing the data to the storage medium with a grain diameter below 100 Å.

Claim 34 (Previously presented): A method for storing data on a storage medium comprising a magnetic disk, the method comprising:

writing the data to the storage medium in which the spacing between adjacent magnetized locations of the magnetic disk is smaller than 50nm whereby the data for a recording density is written at greater than 500 kFCI (19685 kFCm) so as to cause spontaneous degradation of the data over time;

automatically reading the data periodically;

generating a refresh indicator and checking if the refresh indicator satisfies a predetermined condition related to degradation of the data over time; and

writing the data a second time at least in response to said predetermined condition being satisfied;

wherein the data is written to the storage medium with an energy ratio below 50 KuV/KBT at room temperature.

Claim 35 (Previously presented): A method according to claim 34 wherein said predetermined condition is selected by estimating an expected time to occurrence of a

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hard error by any one or more of the steps of (a) empirically determining the duration of operation without errors on a disk during testing, and using this error free duration to generate and store a refresh date, (b) determining the occurrence of a predetermined number of soft errors.

Claim 36 (Previously presented): A method according to claim 34 wherein:

at least a portion of the data is written to a group of grains in a track of the magnetic disk at a density sufficiently high to cause a change in direction of magnetization of at least some of the grains with passage of said time.

Claim 37 (Previously presented): A method according to claim 36 comprising automatically refreshing at least the portion of data, using at least two refresh indicators to write at least the portion of data a second time.

Claim 38 (Previously presented): The method of claim 34 further comprising writing the refresh indicator to a location in the storage medium distinct from another location used to write data.

Claim 39 (Previously presented): The method of claim 38 further comprising using a date of performance of said "writing the data to the storage medium" to determine the refresh indicator.

Claim 40 (Previously presented): The method of claim 39 wherein:

said using includes setting the refresh indicator to be said date; and

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said predetermined condition is satisfied when said refresh indicator is older than a current date by a predetermined time period.

Claim 41 (Previously presented): The method of claim 39 wherein:

said using includes setting the refresh indicator to be a refresh date obtained by adding a predetermined time period to said date; and

said predetermined condition is satisfied when said refresh date is older than a current date.

Claim 42 (Previously presented): The method of claim 34 further comprising:

determining, subsequent to said writing, a difference between a first value of the refresh indicator determined contemporaneous with said writing the data to the storage medium and a second value of the refresh indicator determined at a current time;

wherein said predetermined condition is satisfied when said difference is greater than a predetermined limit.

Claim 43 (Previously presented): The method of claim 34 further comprising using an amplitude of a readback signal of the data as the refresh indicator.

Claim 44 (Previously presented): The method of claim 43 wherein said amplitude is hereinafter "first amplitude" and the method further comprises:

writing the first amplitude to a location in the storage medium distinct from another location used to write the data;

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measuring a second amplitude of the readback signal contemporaneous with said checking; and

said checking includes determining a difference between the second amplitude and the first amplitude.

Claim 45 (Previously presented): The method of claim 44 wherein said checking further comprises comparing said difference with a predetermined limit.

Claim 46 (Previously presented): The method of claim 45 wherein said checking further comprises comparing a percentage value of said difference with a predetermined percentage.

Claim 47 (Previously presented): The method of claim 34 wherein the checking is performed periodically without scanning the entire storage medium.

Claim 48 (Previously presented): The method of claim 34 wherein the refresh indicator is saved contemporaneous with said writing.

Claim 49 (Previously presented): The method of claim 34 wherein said "automatically reading the data" and said "writing the data a second time" are both performed periodically.

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Claim 50 (Previously presented): The method of claim 34 wherein said "automatically reading the data" and said "writing the data a second time" are both performed on a schedule for all the data.

Claim 51 (Previously presented): The method of claim 50 wherein said schedule is periodic.

Claim 52 (canceled).

Claim 53 (Previously presented): A storage medium comprising:

a disk carrying data and having at least one property selected from a group of properties consisting of (a) spacing between adjacent magnetised locations of the disk less than 50 nm (b) recording density for data greater than 500 kFCI (19685 kFCm) (c) grain diameter less than 100 Å and (d) energy ratio less than 50 KuV/KBT so as to cause spontaneous degradation over time;

wherein the disk carries a refresh indicator that indicates a predetermined condition related to degradation of the data over time;

wherein the data is held in a file and the refresh indicator is stored as an attribute of the file.

Claim 54 (Previously presented): The storage medium of claim 53 wherein the attribute is stored in a directory entry of a file system.

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Claim 55 (Previously presented): The storage medium of claim 53 wherein the refresh indicator is based on a time when the data were most recently written.

Claim 56 (Previously presented): The storage medium of claim 53 wherein the refresh indicator is based on an amplitude of a readback signal of the data at the time of writing the data.

Claim 57 (Previously presented): The storage medium of claim 53 wherein the data is held as polarity of magnetized portion of the storage medium.

Claims 58-70 (canceled).

Claim 71 (Previously presented): A method for storing information on a magnetic disk, the method comprising:

writing the information to the magnetic disk, at least a portion of the information being written to a group of grains in a track at a density sufficiently high to cause a change in direction of magnetization of at least some of the grains with passage of a year; and automatically refreshing at least the portion of information, using a refresh indicator;

wherein a transition in polarity between neighboring magnetized portions is less than 250 Å.

Claims 72-76 (canceled).

Claim 77 (Previously presented): A method for storing information on a magnetic disk, the method comprising:

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writing the information to the magnetic disk, at least a portion of the information being written to a group of grains in a track at a density sufficiently high to cause a change in direction of magnetization of at least some of the grains with passage of a year; and automatically refreshing at least the portion of information in response to detection that the information in the magnetic disk contains a soft error.

Claims 78-82 (canceled).

Claim 83 (Previously presented): A method for storing information on a magnetic disk, the method comprising:

writing the information to the magnetic disk, at least a portion of the information being written to a group of grains in a track at a density sufficiently high to cause a change in direction of magnetization of at least some of the grains with passage of a year; and automatically refreshing at least the portion of information, using at least two refresh indicators;

wherein at least one of the refresh indicators is related to a high-frequency component of a readback signal.

Claim 84 (Previously presented): A method for storing information on a magnetic disk, the method comprising:

writing the information to the magnetic disk, at least a portion of the information being written to a group of grains in a track at a density sufficiently high to cause a change in direction of magnetization of at least some of the grains with passage of a year; and automatically refreshing at least the portion of information, using at least two refresh indicators;

wherein at least one of the refresh indicators is related to a number of errors.

Claim 85 (Previously presented): A method for storing data on a storage medium comprising a magnetic disk, the method comprising:

writing the data to the storage medium in which the spacing between adjacent magnetized locations of the magnetic disk is smaller than 50nm whereby the data for a

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recording density is written at greater than 500 kFCI (19685 kFCm) so as to cause spontaneous degradation of the data over time;

automatically reading the data periodically;

generating a refresh indicator and checking if the refresh indicator satisfies a predetermined condition related to degradation of the data over time; and

writing the data a second time at least in response to said predetermined condition being satisfied;

wherein the refresh indicator is stored on the storage medium at a lower density than the data.

Claim 86 (Previously presented): A method for storing information on a magnetic disk, the method comprising:

writing the information to the magnetic disk, at least a portion of the information being written to a group of grains in a track at a density sufficiently high to cause a change in direction of magnetization of at least some of the grains with passage of a year; and

automatically refreshing at least the portion of information, using a refresh indicator;

wherein the refresh indicator satisfies a predetermined condition; and

wherein the refresh indicator is stored on the magnetic disk at a lower density than the portion of the information.

Claim 87 (Previously presented): The method of Claim 77 wherein:

the refresh indicator is stored on the magnetic disk at a lower density than the portion of the information.

Claim 88 (Previously presented): The method of Claim 71 wherein:

the refresh indicator is stored on the magnetic disk at a lower density than the portion of the information.

Claim 89 (Previously presented): A method for storing information on a magnetic disk, the method comprising:

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writing the information to the magnetic disk, at least a portion of the information being written to a group of grains in a track at a density sufficiently high to cause a change in direction of magnetization of at least some of the grains with passage of a year; and automatically refreshing at least the portion of information, using a refresh indicator; wherein the diameter of at least one grain in the group of grains is less than 100 angstroms; and

wherein the refresh indicator is stored on the magnetic disk at a lower density than the portion of the information.

Claim 90 (Previously presented): A storage medium embedded with computer instructions comprising instructions for:

writing data to a magnetic medium wherein the spacing between adjacent magnetised locations of the medium is smaller than 50 nm and the recording density is greater than 500kFCI (19685 kFCm); and

automatically reading the data and writing the data back to the magnetic medium without scanning the magnetic medium;

wherein during each writing the data are recorded at a density sufficiently high to spontaneously undergo thermal degradation with passage of time;

wherein the computer instructions include checking if a refresh indicator satisfies a predetermined condition related to degradation of the data over time;

wherein the computer instructions further comprise[[:]] storing the refresh indicator on the magnetic medium at a lower density than the data.

Claim 91 (Previously presented): A storage medium comprising:

a disk carrying data and having at least one property selected from a group of properties consisting of (a) spacing between adjacent magnetised locations of the magnetic disk less than 50 nm (b) recording density for the data greater than 500 kFCI (19685 kFCm) (c) grain diameter less than 100 Å and (d) energy ratio less than 50 KuV/KBT so as to cause spontaneous degradation over time;

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wherein the disk carries a refresh indicator that indicates a predetermined condition related to degradation of the data over time;

wherein the refresh indicator is carried on the disk at a lower density than the data.

Claim 92 (Previously presented): The method of claim 71 further comprising using an amplitude of a readback signal of the information as the refresh indicator.

Claim 93 (Previously presented): The method of claim 77 further comprising using an amplitude of a readback signal of the information as the refresh indicator.

Claim 94 (Previously presented): The method of claim 86 further comprising using an amplitude of a readback signal of the information as the refresh indicator.

Claim 95 (Previously presented): The method of claim 89 further comprising using an amplitude of a readback signal of the information as the refresh indicator.

Claim 96 (Previously presented): The storage medium of claim 53 wherein the disk carries the refresh indicator at a location distinct from another location carrying the data.

Claim 97 (Previously presented): The method of claim 71 further comprising writing the refresh indicator to a location in the magnetic disk distinct from another location used to write the portion of the information.

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Claim 98 (Previously presented): The method of claim 77 further comprising writing the refresh indicator to a location in the magnetic disk distinct from another location used to write the portion of the information.

Claim 99 (Previously presented): The method of claim 85 further comprising writing the refresh indicator to a location in the storage medium distinct from another location used to write data.

Claim 100 (Previously presented): The method of claim 86 further comprising writing the refresh indicator to a location in the magnetic disk distinct from another location used to write the portion of the information.

Claim 101 (Previously presented): The method of claim 83 further comprising writing at least one of the refresh indicators to a location in the magnetic disk distinct from another location used to write the portion of the information.

Claim 102 (Previously presented): The method of claim 84 further comprising writing at least one of the refresh indicators to a location in the magnetic disk distinct from another location used to write the portion of the information.

Claim 103 (Previously presented): The storage medium of claim 53 wherein the refresh indicator is stored in the disk at a lower density than the data.

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Claim 104 (Previously presented): The method of claim 71 wherein the refresh indicator is based on a time when at least a portion of the information was most recently written.

Claim 105 (Previously presented): The method of claim 77 wherein the refresh indicator is based on a time when at least a portion of the information was most recently written.

Claim 106 (Previously presented): The method of claim 85 wherein the refresh indicator is based on a time when the data was most recently written.

Claim 107 (Previously presented): The method of claim 86 wherein the refresh indicator is based on a time when at least a portion of the information was most recently written.

Claim 108 (Previously presented): The method of claim 71 wherein the portion of the information is written to the magnetic disk with a grain diameter below 100 Å.

Claim 109 (Previously presented): The method of claim 77 wherein the portion of the information is written to the magnetic disk with a grain diameter below 100 Å.

Claim 110 (Previously presented): The method of claim 83 wherein the portion of the information is written to the magnetic disk with a grain diameter below 100 Å.

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Claim 111 (Previously presented): The method of claim 84 wherein the portion of the information is written to the magnetic disk with a grain diameter below 100 Å.

Claim 112 (Previously presented): The method of claim 85 wherein the data is written to the storage medium with a grain diameter below 100 Å.

Claim 113 (Previously presented): The method of claim 86 wherein the portion of the information is written to the magnetic disk with a grain diameter below 100 Å.

Claim 114 (Previously presented): The method of claim 89 wherein the portion of the information is written to the magnetic disk with a grain diameter below 100 Å.

Claim 115 (Previously presented): The storage medium of claim 90 wherein the data is written to the magnetic medium with a grain diameter below 100 Å.

Claim 116 (Currently amended): The method storage medium of claim 91 wherein the data is written to the disk with a grain diameter below 100 Å.

Claim 117 (Previously presented): The method of claim 85 further comprising using an amplitude of a readback signal of the data as the refresh indicator.

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Claim 118 (Previously presented): The storage medium of claim 90 wherein an amplitude of a readback signal of the data is used as the refresh indicator by the computer instructions.

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